THE RAF'S THOR FORCE

KEN DELVE recounts the Royal Air Force's brief involvement, in the late Fifties and early Sixties, with the Douglas Thor intermediate-range surface-to-surface ballistic missile

The Air Estimates for 1958 stated that "Ballistic missiles will gradually [illegible] increasingly important part in the offensive deterrent. Agreement in principle has been reached with the US Government to make a number of American Intermediate Range Ballistic Missiles (IRBMs) available to this country".

On August 29, 1958 the first Douglas Thor IRBM was offloaded from a C-124 Globemaster transport of USAF Military Air Transport Service at Lakenheath. It was then delivered to the newly-formed No 77 (SM) Squadron at RAF Feltwell during November and the Royal Air Force's short-lived venture into the world of strategic missiles was under way.

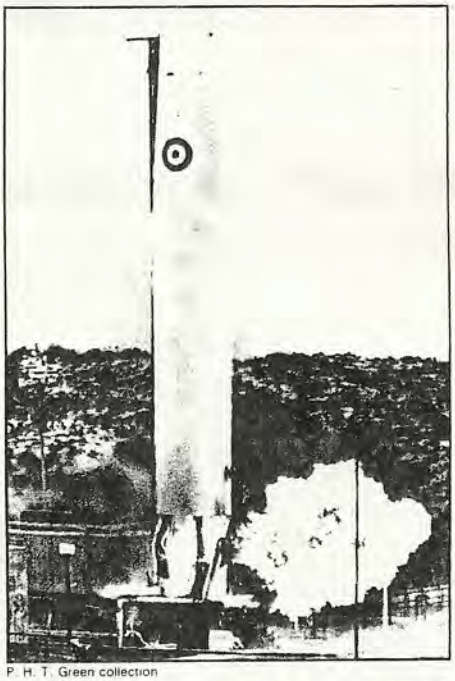
Thor was one of a range of IRBMs and ICBMs (Inter-Continental Ballistic Missiles) being developed by the USA in the mid-1950s as part of the US-Soviet arms race. In American eyes this 1,500-mile range, one-megaton weapon "provided the USA, and SAC [Strategic Air Command], with much-needed weapon-system capability to counter the threat posed by Soviet IRBMs to America's NATO allies. At the same time they furnished positive proof of America's commitment to the defence of Western Europe". Britain was to become the first Western nation to deploy a strategic ballistic missile, and the entire project took place in record time.

It was in November 1955 that the US Department of Defense gave the USAF authority to develop an IRBM—around the same time that the US Army was developing its Jupiter IRBM which eventually saw deployment in Italy and Turkey. The programme got under way in December when SM-75 WS-315A Thor missile was assigned, on the 27th of the month, to Douglas Aircraft as the "prime contractor, responsible for airframe fabrication, systems integration and ground-support equipment". It was a rush programme, although much groundwork on principles and procedures had been covered by the earlier Atlas and Navaho programmes. Nevertheless, it was an impressive performance, with the first round being fired within 13 months and the first overseas squadron equipped within 36 months. The Americans saw a great need for urgency: the Soviet Strategic Rocket Forces were beginning to advance from their early position of using what were essentially modified V2 rockets into true Medium Range Ballistic Missiles; the first of which, the SS-4 Sandal, went operational in 1959 with a very similar performance to Thor.

In mid-1956 the American government made its initial approaches to the British Government about adopting the Thor system. The pace increased the following January with a briefing in Washington to a British Joint Services Mission which gave the proposal a very mixed reception. Formal agreement was reached between Eisenhower and Macmillan as part of their Bermuda meeting in March 1957, with implementation of the proposals planned for 1958. The intention was for the USA to provide the weapons, special equipment and warheads on the same basis as the American weapons used on the V-bombers, i.e. under American ownership but with dual-key control. For its part, the UK would provide the launch sites and manpower and it would be operated as a system by the RAF.

The decision to adopt Thor did not meet unreserved support. It was a time when some foresaw the end of the manned aircraft as the era of strategic missiles dawned; others, however, amongst them

RAF Museum photograph



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Above left, *a Thor undergoing its pre-launch checks during CTL at Vandenburg AFB.* **Above**, *Missile 31 of No 98 (SM) Squadron powering its way up the launch rail on April 18, 1960, again at Vandenburg AFB.*

Air Force the next day as a "going concern".

It was a similar story at all the launch sites as the RAF ballistic missile system was brought up to strength. Launch-pad numbering was consecutive starting from Feltwell, so the three Feltwell pads were 1, 2 and 3 with other squadrons as they formed taking the next numbers in the sequence.

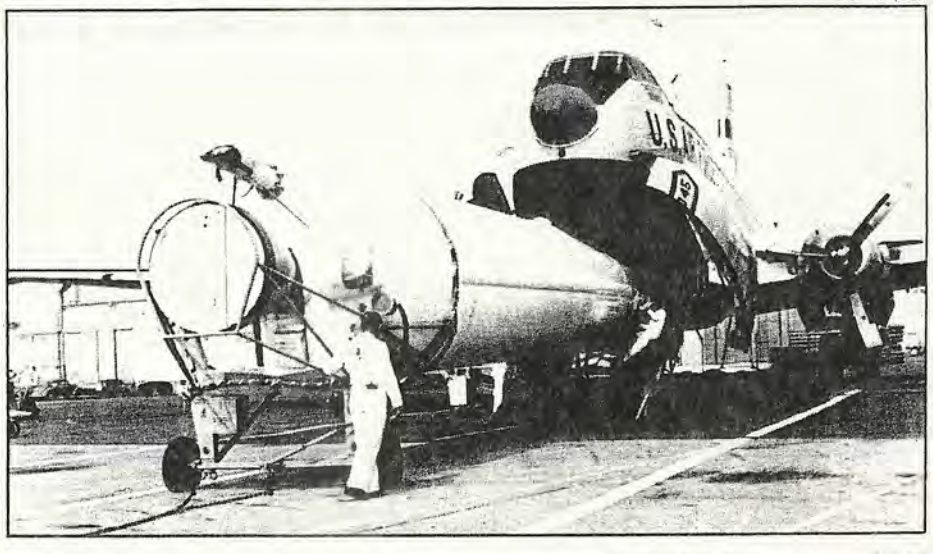
The heart of the system was, obviously, the missile itself, which Douglas had planned as a single-stage missile capable of a 1,500 nautical mile mission range. This, to deliver a warhead of around one megaton, equivalent to one million tons of TNT, would mean an overall gross weight of around 100,000lb. Powerplant selection was somewhat constrained by the USAF requirement that it should use liquid oxygen (LOX) as an oxidant and RP-1, a light-cut petrol, as the fuel. This was mainly for logistical reasons but in the event proved to be no problem, as the Rocketdyne Division of North American Aviation already had a suitable contender under development. This rocket, the LR-79, producing a thrust of 150,000lb, was duly developed for use in Thor. The experimental XLR-79 was used in compatibility tests in mid-1956. As there was really nothing new, no major problems arose and production deliveries commenced in July 1957.

All missiles are essentially the same with warhead, guidance, fuel and engine. In the case of Thor some two-thirds of its 60ft length was taken up with fuel tanks, below which was the LOX tank and then the engine. Above the main fuel tanks sat the airborne portion of the guidance system, which was an inertial system developed by the AC Spark Plug Division of General Motors. The system was developed from existing inertial systems because of the timescale, but incorporated miniaturised gyros and accelerometers in order to fit in and withstand high acceleration and vibration. A fairly standard three-gimbal arrangement was used with associated resolvers, synchros and potentiometers whose outputs were fed to the digital computer. This in turn fed course corrections to the sustainer motor and two verniers.

As a system one of the major criticisms of Thor was its vulnerability because of overground fixed-site operation—a very valid point. The ground support equipment required for the missile was extensive and started with the actual building of the launch pads of the complex, each of which had to be carefully constructed. Once the missile had been delivered on its mobile transporter/erector it was attached to the launcher. This was a massive 30,000lb stand, part of which was hinged to put the missile into its vertical launch position. Alongside the launcher were a service tower and an umbilical mast, the latter to provide electrical and fuel services to the missile up to the moment of launch. Environmental protection for the missile was provided when it was in the horizontal position by a light metal hangar which was on rails so that it could be rolled away from the missile when the latter was ready for erection. The cruciform shape of the launch area also contained the above-ground storage tanks for the propellants, various ancillary equipment and the support and control trailers. Of these the most important were the Missile Check-out Trailer (MCOT) and the Launch Control Trailer.

Each RAF squadron had a nominal strength of 60 personnel comprising six officers, 29 SNCOs and 25 other ranks. This gave five six-man launch teams, plus general admin personnel and RAF Police. This number of teams was necessary to provide sufficient crews for the 24hr-a-day, 365-days-a-year operational standby requirement of the Thor squadrons as part of Bomber Command's nuclear deterrent. Each launch team consisted of a launch control officer, launch control console operator (officially, Launch Monitor Console Op—LMCO—a position held by NCO aircrew), three missile maintenance technicians (MMT) and an electrical fitter/mechanic. The LCO initiated and progressed the countdowns and maintained overall

The Aeroplane

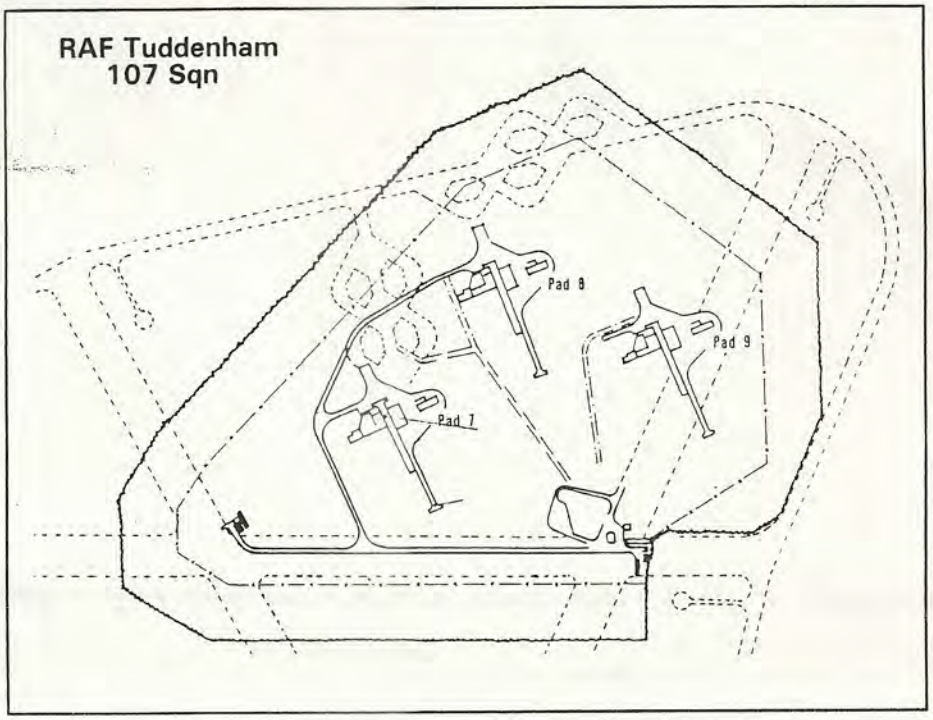


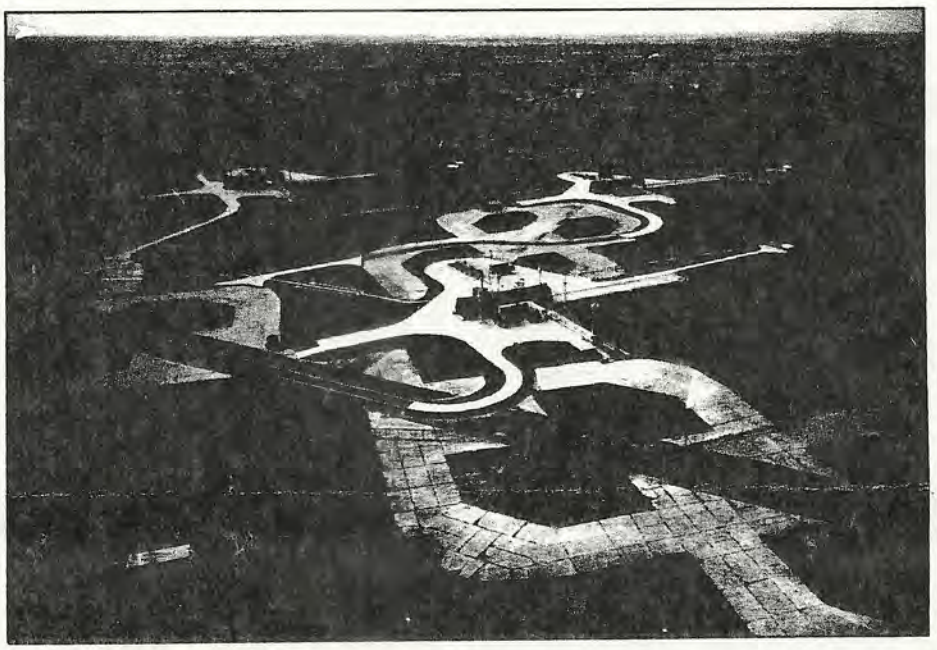
Right, *the RAF's 60th and last Thor arrives at RAF Luffenham in March 1960 and is disgorged from a Douglas C-124 Globemaster, having been flown in from Santa Monica.*

the Chiefs of Staff, were reluctant to spend an estimated £10 million on a system that was largely untried and was, as a fixed site, very vulnerable to attack. As usual, a political decision having been made, it was up to the military to implement it as best it could.

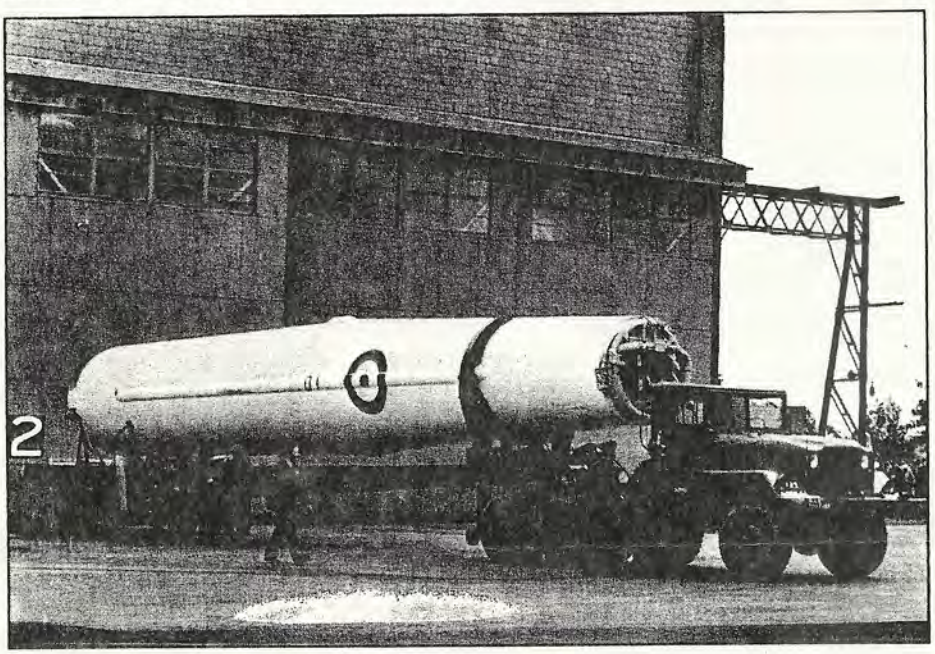
The initial proposal was for four squadrons, each with 15 missiles, to be deployed to 20 dispersed sites. Each squadron would have a main headquarters airfield site and five firing sites, one of which would be at the HQ site, designated A to E Flights. When announced towards the end of 1958, the plan was for 77 (SM) Squadron at Feltwell to have satellites at Mepal, North Pickenham, Shepherds Grove and Tuddenham; 97 (SM) Squadron at Hemswell with satellites at Ludford Magna, Bardney, Coleby Grange and Caistor; 98 (SM) Squadron at Driffield with satellites at Carnaby, Catfoss, Breighton and Full Sutton; and 144 (SM) Squadron at North Luffenham with satellites at Folkingham, Polebrook, Harrington and Melton Mowbray. Each HQ site would be responsible for general administration and management of the squadron's satellites and would be the receiving site for missiles, which would then be transported by road to the satellite site.

Within a year the initial plan had changed so that each launch site would be a squadron in its own right, although the five squadrons of each original network would continue to be administered as a single complex. Thus the HQs and satellites listed above became: 77 Sqn with 82, 107, 113 and 220 Sqns; 97 Sqn with 104, 106, 142 and 269 Sqns; 98 Sqn with 150, 226, 240 and 102 Sqns; and 144 Sqn with 223, 130, 218 and 254 Sqns. All carried the designation (SM) denoting their role as Strategic Missile squadrons. However, many of them had formed under the original A to E designations and their renumbering as squadrons was then made retrospective.





Left, *an American-based Thor leaves the launch pad.* **Right**, *aerial view of an RAF Thor site showing the arrangement of the three launch pads with their protective hangars and ancillary buildings; note also the security fence round the site which, like most of its brethren, was built on a disused airfield.* **Below**, *the arrival of the RAF's first Thor at Feltwell in November 1958 for 77 Sqn. It had been flown into RAF Lakenheath from the USA.*



The first of them, 77 Sqn, duly formed at Feltwell in September 1958 ready to receive its first Thor missile. Feltwell had been the scene of hectic activity as the concrete launch emplacements and ancillary buildings were constructed. The timetable of events was fairly standard, and 142 Sqn serves as a good example. The squadron re-formed at Coleby Grange in July 1959, having disbanded as a Venom squadron that March. The site had been taken over from the contractors in May but was in the hands of Douglas Co technicians in July and August for installation of the actual system. This was duly completed and, on September 2, technicians of the USAF 7th Air Division, acting as agents for the Thor, carried out final acceptance checks. The missile complex was handed over to the Royal

control. The LCO had a "shadow" in the person of the USAF authentication officer, standard practice because American warheads were involved. The LMCO's job was to monitor the countdown on a particular pad and relay information to the LCO. The MMT, or missile system chiefs (MSC), were at the individual pads and were effectively pad controllers with responsibility for checking equipment status and monitoring the launch. Lastly, the electrical fitter, also known as the EPPO (Electrical Power Production Operator), ensured that sufficient electrical power was available from the generators for the launch of all three missiles.

The squadron also had three specialists—a missile system analyst technician and two guidance personnel—to rectify minor snags in the system. Because of the sensitive nature of the site, each also had a complement of four RAF Policemen.

All in all it was an unusual situation for the 1,200 RAF personnel who manned the 20 squadrons. The 60 Thor missiles incorporated into the Bomber Command Alert and Readiness system provided an enormous potential punch and if the experts were to be believed this was the dawn of a new era. However, it turned out very differently: what should have proved a career springboard in the new world of missiles became instead a career backwater, as no RAF system took over after the Thors were returned to the USA.

In 1959 it was not generally known that the Thor deployment would be for a limited period, and for those selected to man the Thor sites it was a challenging time that many of them welcomed. Before arriving at the squadron site there was a little matter of six months'-worth of courses. For the officers this started with a two-month "ballistic missile lead-in course" at Manby. Next came the good bit, with up to three months in America, one month at the Douglas factory at Tucson and then a two-month practical course at Vandenburg which culminated in a live firing.

By May 1960 all the squadrons were operational and the standard routine of countdowns, fuel flows and exercises was under way. For the system to have any effect, deterrent or otherwise, it had to be held on permanent standby to prevent pre-emptive strike, and any down-time had to be kept to the minimum. This required constant checking and monitoring of the various missile components and the capability of its launch crews. There was a whole range of checkout options ranging from the "dry disabled", i.e. no propellant flow and the missile staying in its shelter, to "wet enabled" where the missile was fuelled-up and erected. The latter varied from a single flow of one propellant on one launch pad to the somewhat rarer "TRIPLOX" which gave a single LOX flow to all three missiles at the same time. This was infrequent because it required three crews for safety reasons, and that played havoc with the shift systems. It was, however, spectacular, with clouds of liquid oxygen drifting from the launch pads like a rock concert!

The daily routine was one of squadron training, with one or two countdowns a day down to as little as launch minus 2min, although it was much more common to halt at around launch minus 8min. In essence, the countdown was divided into a standby state and five launch phases:

STANDBY—Missile inside its metal hangar and minimum equipment in use. Nosecone monitored electronically and guidance system kept warmed up.

PHASE I—Electronic checking of systems and alignment of guidance system against surveyed ground theodolites.

PHASE II—Missile shelter rolled away and missile erected.

PHASE III—Main fuelling phase. LOX and fuel pumped into the missile tanks by nitrogen pressure. When completed, the erecting boom is lowered.

PHASE IV—Power transferred to missile batteries. Authentication Officer turns his key.

PHASE V—LOX topped up, fuel tanks pressurised, ignition and lift-off.

On top of squadron training came Bomber Command exercises of various types, of which the most important were the "no-notice" exercises calling for all pads to be brought to maximum readiness from normal standby. The system gave few overall problems although various mods, especially to the guidance system, were incorporated in the first 2yr of service.

Two major concerns were fire and security, so both were heavily rehearsed. Simulated fires were an almost daily happening and crews became expert at dealing with all sorts of most unlikely combinations! On the security side there was the odd "brush" with CND but mostly it was a question of one site being "attacked" by an RAF Police team or by intruders from one of the other squadrons within the same group of sites. The aim was to get onto the launch pads and "score a point" on a rival squadron. Security, however, proved to be very tight.

A major problem was that of keeping up morale at what were small, self-contained units that because of the nature of the job kept personnel in tight little groups. As individuals they were under strain by not being able to say much about what they were doing. At first the problem did not really exist, as it was a new world, exciting and with prospects. The plan in the late 1950s was for Britain to develop its own strategic missile which would supplant Thor. The Blue Streak system was designed as a silo-launch missile to overcome the problem of vulnerability and with more up-to-date guidance systems seemed to ensure a future for the SM force. However, the Blue Streak programme was abandoned in April 1960. The original Thor agreement was only signed for 5yr and so with the demise of the Blue Streak the SM force seemed to have a short future unless something else was forthcoming. This situation did nothing to help morale: all of a sudden there seemed to be little prospect.

There was one good part of the job, which came about as part of the checking of missiles and crews. This was the Combat Training Launch (CTL) which involved crews going to Vandenburg to fire a missile which had been on one of the RAF pads. Only 12 such CTLs took place, so by no means all crews had a go and the only missile they were likely to have seen fired was that at the end of their original Vandenburg course. The CTL used the same systems and procedures as the squadrons used on a day-to-day basis so the 98 Sqn exercise *Lions Roar* in early 1959, the first RAF launch, was typical. The unit carried out simulator training on procedures and malfunctions, and the firing date was set for April 14. A few minor snags saw the launch delayed to April 16.

"Attention all stations, this is the Launch Control Officer. On my mark the terminal launch countdown will begin .... 5..4..3..2..1..MARK!" On the executive word "Mark" the sequence key would be turned and the automatic sequence started. The guidance system was aligned and checked and the shelter rolled away. Next, the missile slowly rose to its vertical firing position and propellants flowed into it. Within only a few minutes an amber light signalled that the engine was about to start, and 5sec later the missile was on its way. It was an awesome sight as the blinding glare of the powerful engine lifted the white missile into the air, while the roar deafened even those in the launch trailer.

Out of a total of 12 RAF firings only two were unsuccessful. The last CTL took place in June 1962, only a month after the US Secretary of Defense had signalled the end of the Thor force. He announced that support for the RAF Thor force would end on October 31, 1964, although there was always the option of a British-financed continuation of the system. In August the MoD announced that Thor would be phased out by the end of 1963 and that there would be no British replacement. In the event, the end came even quicker than that. Trial dismantling of installations began in late 1962 and the Thor squadrons disbanded between April and August 1963. The last missile was flown back to the USA on September 27, 1963. It was the end of a very short-lived venture by the RAF into the world of strategic missiles—but the missiles themselves had a new and successful lease of life in the American space race.

Missile 15 of 107 Sqn, based at Tuddenham, sits upright ready for the next phase in the practice launch sequence.

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